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Mark Scheme (Results)
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GCE

GCE Design & Technology (6142/01)

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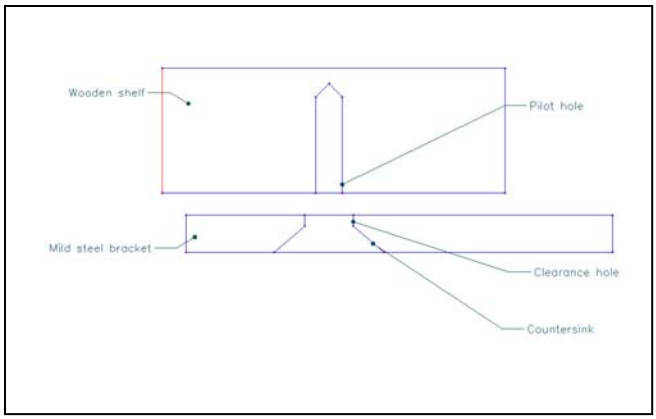
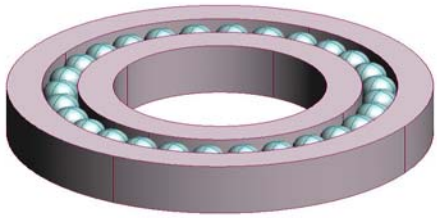
Product Design: Resistant Materials Technology (6142/01)					
Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q01a			**Name <u>two</u> other permanent joints suitable for joining the two mild steel components:**		
1	(a)		**Candidates may give any TWO Permanent joints from the following:** • Welding (MIG/TIG/Arc/Oxy-acetylene/Spot) **(1)** • Brazing **(1)** Only answers.	2x1	**(2)**
6142_01_Q01b			**Name <u>two</u> semi-permanent joints suitable for joining the two mild steel components:**		
1	(b)		**Candidates may give any TWO Semi-permanent joints from the following:** • Nuts and bolts **(1)** • Machine screws **(1)** • Self tapping screws **(1)** Only answers.	2x1	**(2)**

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q01c			**In the space below, draw a labelled diagram to show the pilot hole and countersunk clearance hole.**		
1	(c)		**Candidates may give a labelled diagram that makes reference to the following THREE points:** • Pilot Hole **(1)** • Clearance Hole **(1)** • Countersinking **(1)** 	3x1	**(3)**
6142_01_Q01d			**State the purpose of using countersunk head screws.**		
1	(d)		**Candidates may give any ONE of the following answers:** • In order to get the head of the screw 'flush' with the surface of the material. **(1)** • The surface area of countersinking is greater. **(1)**	1x1	**(1)**
					(Total 8 marks)

Question number			Question / Expected answers	Mark allocation	
6142_01_Q02a			**Explain the following terms in relation to the mechanical properties of materials. Elasticity:**		
2	(a)		**Candidates may give an explanation that makes reference to:** • The ability of a material to return to its original shape and form **(1)** once the deforming force has been removed / without damage / deformation **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**
6142_01_Q02b			**Explain the following terms in relation to the mechanical properties of materials. Ductility:**		
2	(b)		**Candidates may give an explanation that makes reference to:** • The ability of a material to be drawn down / stretched / pulled **(1)** into a longer / thinner cross-section / e.g. wire **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**
6142_01_Q02c			**Explain the following terms in relation to the mechanical properties of materials. Hardness:**		
2	(c)		**Candidates may give an explanation that makes reference to:** • The ability of a material to withstand wear **(1)** scratching **(1)** indentation **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q02d			**Explain the following terms in relation to the mechanical properties of materials. Malleability:**		
2	(d)		**Candidates may give an explanation that makes reference to:** • The ability of a material to be beaten / pressed / formed / moulded / deformed into a shape **(1)** without breaking of fracturing when worked hot or cold **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**
					(Total 8 marks)

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q03a			**In the space below, sketch a ball bearing.**		
3	(a)		**Candidates may give a sketch that makes reference to:** • Inner race **(1)** • Outer race **(1)** • Balls **(1)** 	3x1	**(3)**
6142_01_Q03b			**Explain <u>one</u> reason why a bush would be used in preference to a ball bearing:**		
3	(b)		**Candidates may give an explanation that makes reference to:** • They are used for low speed applications **(1)** where a high force is required **(1)** • They have the ability to withstand great pressures **(1)** without a reduction in performance **(1)** • They are relatively cheap to purchase **(1)** because they are a much simpler component **(1)** • A bush has fewer parts **(1)** which means reduced chance of failure **(1)** • The dimensions of a bush can be made to suit the application **(1)** they are not governed by the size of the balls within a ball bearing **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q03ci			**Describe the kiln seasoning process.**		
3	(c)	i	**Candidates may give a description that makes reference to any 4 of the following:** • The ends of the timber are treated to prevent splitting **(1)** • Timber is stacked using 'stickers/sticks' between the planks in order to allow optimum circulation of air **(1)** • The timber is placed into a sealed chamber so that the environment can be controlled **(1)** • Steam is pumped into the chamber which is absorbed into the timber to ensure and even moisture content throughout the stock **(1)** • The humidity is then drawn out by extractor fans to remove excess moisture in the environment **(1)** • The temperature is raised as hot air is circulated around the chamber so that the moisture is drawn out of the timber **(1)** • The environment is carefully monitored for a set period to attain the precise moisture level required **(1)** *1 mark per point*	4x1	**(4)**

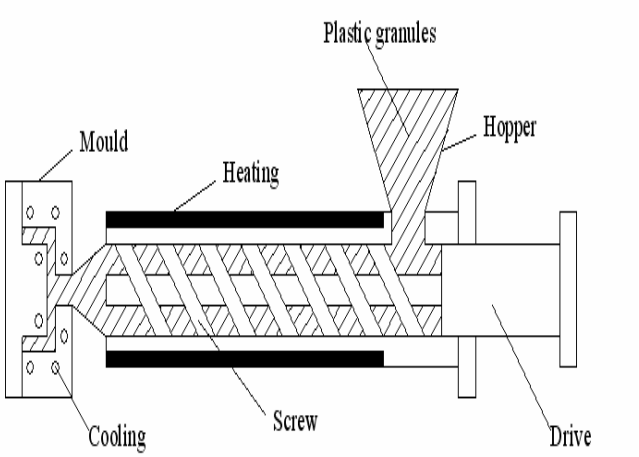
Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q03cii			**Give <u>two</u> advantages of kiln seasoning over natural seasoning.**		
3	(c)	ii	**Candidates may give any two advantages from:** • Speed at which timber can be dried and therefore sold **(1)** • Less space is required as the process is quicker **(1)** • Insects/bugs etc get killed as part of the process **(1)** • Accuracy of final moisture content **(1)** • A completion date can be specified more accurately **(1)** • The pace of drying can be accurately controlled **(1)**	2x1	**(2)**
6142_01_Q03ciii			**Give <u>one</u> disadvantages of kiln seasoning over natural seasoning.**		
3	(c)	iii	**Candidates may give any disadvantage from:** • Cost of energy required to complete the process **(1)** • Varying sections of timber cannot be kiln dried simultaneously **(1)** • Initial set-up costs are relatively high **(1)** • The timber can be over heated causing 'case-hardening' which results in a brittle surface to the timber **(1)** • Timber dried too quickly is more prone to end splits **(1)**	1x1	**(1)**
					(Total 12 marks)

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q04a			**Explain <u>two</u> reasons why a jig would be used in the manufacture of this bracket.**		
4	(a)		**Candidates may give any two explanations from the following:** • So that the holes are placed accurately in the bracket **(1)** because otherwise the operating efficiency of the bracket would be reduced **(1)** • So that a number of the brackets can all be made to the same specification **(1)** which ensures quality control / reduce human error / reduced inaccuracy of manual measurement **(1)** • So that the brackets could be made more quickly **(1)** which enables the company to increase production/profit / reduce need to measure each time **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1 2x1	**(4)**

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q04bi			**Give <u>four</u> advantages of the Just in Time (JIT) production system.**		
4	(b)	i	**Candidates may give any FOUR Advantages of JIT from:** • It enables many variations on the assembly line **(1)** • It is production with minimum waste / error (e.g. materials **(1)** time **(1)** labour) **(1)** • Operational set-up / scheduling times are reduced, increasing flexibility and the capacity to produce smaller batches more cost effectively **(1)** • There is a multi-skilled workforce that is capable of operating multiple processes, leading to greater productivity, flexibility and increased job satisfaction – TQM (Total Quality Management) **(1)** • Reduced storage/warehouse facilities are needed **(1)**	4x1	**(4)**
6142_01_Q04bii			**Explain <u>one</u> disadvantage of a Just in Time (JIT) production system.**		
4	(b)	ii	**Candidates may give an explanation that makes reference to:** • It is totally dependent on suppliers **(1)** otherwise components and materials will not get there just before they are needed **(1)** • It is a complex manufacturing system **(1)** which requires a high degree of initial expenditure **(1)** • Relatively high transport cost **(1)** due to frequent delivery **(1)** • Increasing technology **(1)** leads to a need for staff retraining **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**
					(Total 10 marks)

Question number			Question / Expected answers	Mark allocation	
6142_01_Q05a			**Give <u>three</u> reasons why High Impact Polystyrene is an appropriate material for the case of the mouse.**		
5	(a)		**Candidates may give any THREE reasons from:** • Can be formed into intricate shapes **(1)** • Takes a fine surface texture well **(1)** • Suitably strong /tough / scratch resistant material for intended usage **(1)** • HIPS is an insulator so it is warm to the touch and therefore comfortable to handle for long periods **(1)** • Available in a range of colours **(1)** • Light weight for ease of use **(1)** • Easily cleaned **(1)** • Recyclable **(1)** • Easily moulded **(1)**	3x1	**(3)**
6142_01_Q05b			**Describe <u>two</u> quality control checks that would be carried out on the finished mouse.**		
5	(b)		**Candidates may give any TWO descriptions from:** • Finish **(1)** – Visual or tactile inspection – misforming – sharp edges **(1)** • Function **(1)** – practical test – plug into PC to check or operations **(1)** • Accuracy **(1)** – practical test for dimensional accuracy – to check speed / ease of assembly **(1)**	2x1 2x1	**(4)**
6142_01_Q05c			**Explain why the body of the mouse would be batch produced.**		
5	(c)		**Candidates may give an explanation that makes reference to:** • Numbers produced can be matched to customer demand **(1)** • A range of options can be offered e.g. colour, style, functions **(1)** • Once the mould has been created the cost of further batches (to match demand) is relatively low **(1)** • No need to store materials as they can be ordered when a new batch is commissioned **(1)**	3x1	**(3)**
					(Total 10 marks)

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q06a			**Name a specific plastic which would be used for the manufacture of the chair seat.**		
6	(a)		**Candidates may give suitable material from:** • Polypropylene **(1)** • HDPE **(1)** Only answers.	1x1	**(1)**
6142_01_Q06bi			**Describe how the chair can be modelled using rapid prototyping.**		
6	(b)	i	**Candidates may give a description that makes reference to:** • The chair seat would be drawn using a suitable CAD package **(1)** • The image is then 'sliced into electronic layers' and exported (in a suitable format) to a Rapid Prototyping machine **(1)** • RPT works on the principle of building up layers of a material whose physical shapes are representations of electronic 'slices' taken through a digital model. **(1)** • It is sometimes called Layered Object Modelling (L.O.M.) **(1)** • The process can be done using 'tool-less' cutting technology such as the use of lasers which are used to solidify liquid polymers in a process called stereolithography. **(1)** • More simply, layers of adhesive card/paper can be cut and assembled to form a 3d prototype **(1)**	3x1	**(3)**
6142_01_Q06bii			**Give <u>two</u> advantages of rapid prototyping over traditional methods of modelling.**		
6	(b)	ii	**Candidates may give any TWO advantages from :** • The need for less skilled workers (cost implication) **(1)** • Reduced waste **(1)** • More accurate models **(1)** • Speed of modeling is increased **(1)** • Ability to accurately repeat the process **(1)** • Link between CAD and CAM is easy / quick **(1)**	2x1	**(2)**

Question number			Question / Expected answers	Mark allocation	
6142_01_Q06c			**In the space below, draw a labelled diagram of the injection moulding process.**		
6	(c)		**Candidates may give a labelled diagram that makes reference to:**  Candidates may also refer to: • Ejector pins **(1)** • Molten plastic **(1)**	6x1	**(6)**

Question number			Question / Expected answers	Mark allocation	
6142_01_Q07ai			**Explain the term 'Anthropometric data'.**		
7	(a)	i	**Candidates may give an explanation that makes reference to:** • This is the name given to the study of human physical measurements **(1)** which are used in relation to the objects which are used by people / a specific example e.g. hip to knee or shoulder to hand **(1)** *2 marks per justified point* *Max 1 mark per point without justification*	2x1	**(2)**
6142_01_Q07aii			**Describe how 'Ergonomics' may be used in the design of a product.**		
7	(a)	ii	**Candidates may give a description that makes reference to:** • When using ergonomics it is important to take account of the greatest range of sizes of users of the product **(1)** • Generally designers work on a figure of 90% of users being able to use the product comfortably as it would be 'impossible' to design for 'everyone' as the range is too great **(1)** • Ergonomics makes use of anthropometric date to make sure that products can be used comfortably by the people for whom they were designed / This may be a general e.g. a car seat which is designed for the average person to use in relative comfort / or very specific e.g. a 'made to measure' seat for a racing car, made to fit only the one driver in an optimum position whilst racing **(1)** • Sometimes it is the relationship between two items that give rise to the need for ergonomic consideration / The distance between a chair seat and table top is important for comfortable use/as is the relationship between the position of a computer keyboard, the mouse and the monitor **(1)** • Safety considerations can also drive ergonomic positioning / For example the on/off switch on a machine is important/On a drill the trigger needs to be positioned so that it can be pulled easily whilst the drill is being used/However on some machines the on/off switch is deliberately placed so that it cannot accidentally be switched on causing an accident **(1)**	4x1	**(4)**

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q07b			**Describe how production benefits from the use of CNC machines for manufacture.**		
7	(b)		**Candidates may give a description that makes reference to:** Benefits of using CAM: • Cam can be used to link with CAD in modeling techniques like RPT in the rapid production of physical models **(1)** • Products are made accurately **(1)** • Operations can be carried out with repetitive accuracy **(1)** • They are economical to operate (after high initial set-up costs) **(1)** • CAM can be used in a range of potentially hazardous environments **(1)** • CAM has operational flexibility as they can be used for one-off, batch or mass production **(1)** • CAM allows automated material handling, storage and retrieval systems to be used **(1)** • CAM allows for quick response systems **(1)** • Production level can be directly linked to customer needs **(1)** • Materials can be ordered as needed thus reducing need for stockpiling and costly storage space - J.I.T. **(1)** • CNC machines have increased the scope for the complexity of machining operations **(1)** • There is generally less waste – both material and time **(1)** • Production costs are reduced due to less labour cost **(1)** • The speed of product is increased **(1)**	6x1	**(6)**
					(Total 12 marks)

Question number			*Question / Expected answers*	*Mark allocation*	
6142_01_Q08a			**Evaluate the impact of global manufacturing on developing countries with reference to: Employment issues:**		
8	(a)		**Candidates may give an evaluative answer that makes reference to:** • It can provide employment and higher living standards **(1)** • It may improve the level of expertise of the local workforce **(1)** • Increased mechanisation means a reduced need for local labour **(1)** • Jobs provided may only be low skill level **(1)** • Managerial roles are often only filled by employees from developed countries **(1)** • Health and safety standards may be low in developing countries **(1)** • Wages may be low / working conditions poor **(1)** • Products produced may be too expensive for local consumption **(1)** • Locally customs / beliefs / cultures **(1)** • Multinationals can set up and pull out at any time leaving local unemployment issues **(1)**	4x1	**(4)**
6142_01_Q08b			**Evaluate the impact of global manufacturing on developing countries with reference to: Effects on the environment:**		
8	(b)		**Candidates may give an evaluative answer that makes reference to:** • It can cause environmental damage – emissions/unsightly manufacturing plants **(1)** • Raw materials are often exported rather than being processed in developing countries **(1)** • The need for increased infrastructure **(1)** • Multinationals can set up and pull out at any time leaving the local economy in trouble and large redundant manufacturing plants**(1)** • Increase pollution due to extensive transportation of materials / products **(1)** • Waste materials are 'dumped' and not recycled efficiently **(1)**	4x1	**(4)**
					(Total 8 marks)
					TOTAL FOR PAPER: 80 MARKS